Space Weather Technical Forecast

Issued on Thursday, 19 January 2023 at 12:36 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further R1/R2 Radio Blackouts likely. Chance of G1/Minor Geomagnetic Storms through to day 3 (21 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate through the past 24 hours, with three M1 flares observed, peaking at M1.8 at 19/1012UTC and emanating from AR3196 (Cro/Beta). This is a small region located in the northeast, with the same region producing a smaller M1 flare six hours earlier. The other M1 flare emanated from the remnants of ex-3188 in the southwest of the disc at 19/1027UTC. The largest region remains AR3190 (Eki/Beta-Gamma), approaching centre disc in the southern hemisphere. The other relatively large and complex region is AR3192 (Fki/Beta-Gamma-Delta), also approaching centre disc in the north, and which still contains a very weak delta spot. There are currently eight numbered and one un-numbered sunspot regions on the visible disc, with the remaining regions smaller and appearing either stable or in slight decay, except the re-emergence of some weak spots associated with AR3194 in the southwest.

No new Earth-directed CMEs have been observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds were mainly in the range 450-360km/s, with density largely average. The IMF increased a little after 19/0400UTC reaching moderate levels, peak 10 nT. The north-south component was mostly weakly positive (northward) until around 19/0300UTC, with more sustained negative (southward) orientation thereafter, peak -8 nT. The phi angle was predominately positive (away from the Sun). Geomagnetic activity was largely Quiet (Kp 0-2), with Potsdam and NOAA/SWPC recording an Unsettled period 19/0600-0900UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has been at Background levels throughout.
High energy electron flux (greater than 2 MeV) has been at background levels. The 24-hour integrated electron fluence stayed below the Active threshold on a downward trend, with 6.44e6 integrated pfu observed at 18/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate, with a slight chance of reaching High levels. There are numerous regions on the disc, but the most obvious candidates for a significant flare are AR3190 and AR3192.

Solar Wind / Geomagnetic Activity: A CME that was launched on 14 January may give a glancing blow early on Day 1(19 Jan). A further HSS from CH68 may connect with Earth during Day 2 (20 Jan) into day 3 (21 Jan), this could potentially increase solar wind speeds to around 600 km/s, although this is low confidence.

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Geomagnetic activity is expected to be Quiet to Unsettled with occasionally Active intervals possible, and a Chance of isolated G1/Minor Storm intervals through to day 3 (21 Jan), lowering to a slight chance on day 4 (22 Jan) as CH HSS effects start to wane.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is likely to remain at predominantly background levels, but with a slight chance of reaching S1 or greater through the period.

High energy electron flux is likely to remain at background to moderate levels for much of the period, with a possible increase later in the period. As such, electron fluence is likely to stay below the Active threshold for much of this period, but with an increasing trend into Day 4 (22 Jan).

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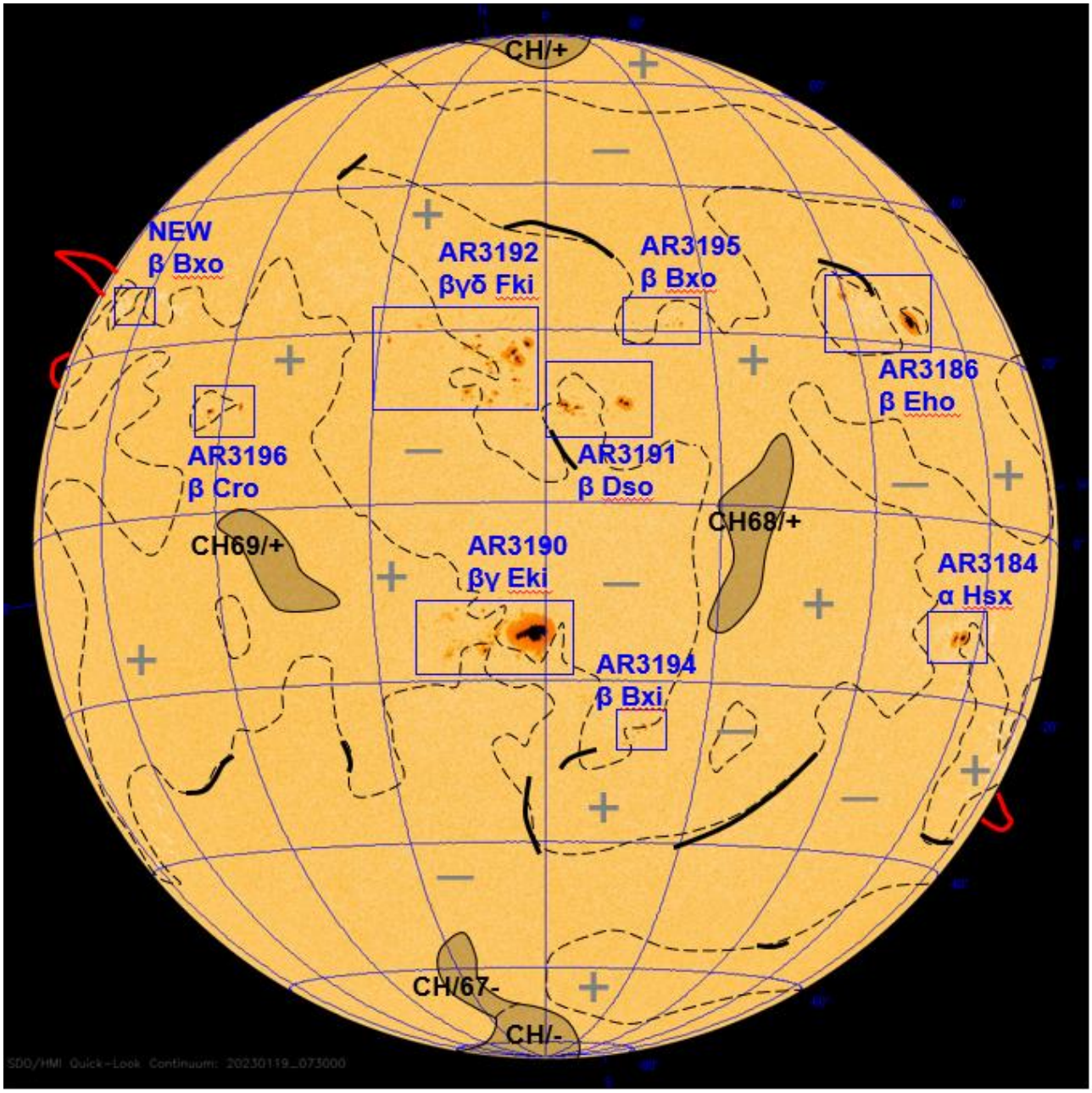
Figure 1. Solar Analysis Valid 19/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar wind speeds are slightly elevated to background levels, however, a CME that was launched on 14 January may give a glancing blow early on Day 1 (19 Jan). A further HSS from CH68 may connect with Earth during Day 2 (20 Jan) into day 3 (21 Jan), this could potentially increase solar wind speeds to around 600 km/s. However, this coronal hole appears to be a much weaker feature than on the previous rotation, so the likely magnitude of associated solar winds is uncertain and probably lower.

Geomagnetic activity is expected to be Quiet to Unsettled with occasionally Active intervals possible, and a Chance of isolated G1/Minor Storm intervals through to day 3 (21 Jan), lowering to a slight chance on day 4 (22 Jan) as CH HSS start to wane.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	40	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
15/0900	Partial	AR3182	SW	400km/s	19/0001UTC	Glancing blow possible

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Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate through the past 24 hours, with three M1 flares observed, peaking at M1.8 at 19/1012UTC and emanating from AR3196 (Cro/Beta). This is a small region located in the northeast, with the same region producing a smaller M1 flare six hours earlier. The other M1 flare emanated from the remnants of ex-3188 in the southwest of the disc at 19/1027UTC. The largest region remains AR3190 (Eki/Beta-Gamma), approaching centre disc in the southern hemisphere. The other relatively large and complex region is AR3192 (Fki/Beta-Gamma-Delta), also approaching centre disc in the north, and which still contains a very weak delta spot. There are currently eight numbered and one un-numbered sunspot regions on the visible disc, with the remaining regions smaller and appearing either stable or in slight decay, except the re-emergence of some weak spots associated with AR3194 in the southwest. Far-side soundings suggest further regions may rotate onto the disc in the coming days, probably acting to maintain the risk of M-class flares through this period.

Solar activity is likely to be Moderate, with a slight chance of reaching High levels.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is currently at background levels.
While no recent S1+ events have been observed at GEO, the sheer number of both front and far-sided complex groups dictates an elevated risk. While the relative contribution to the risk will decrease through the coming days for Ex-3182, both AR3190 and AR3192 bring an increasing risk as they rotate westwards. As such, a slight chance of S1 or greater continues through this four day period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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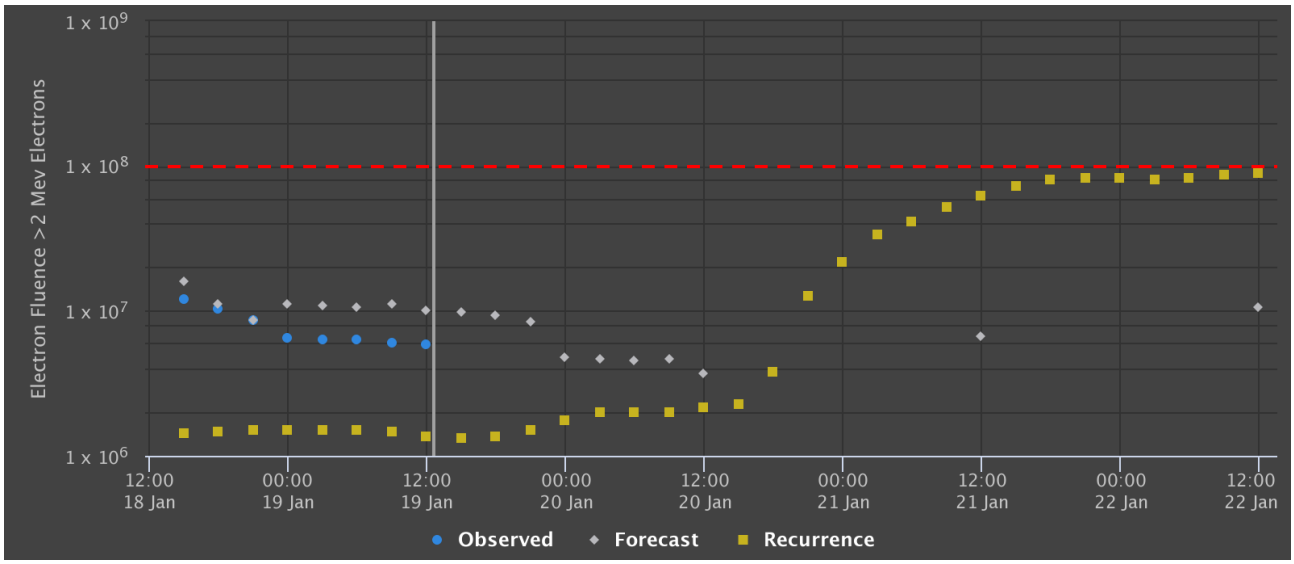
High Energy Electrons Event (≥ 2MeV):

High energy electron flux has remained at background to moderate levels over the past 24 hours. The possibility of a glancing blow from a CME is likely to continue the suppression through Day 1 (19 Jan) with a further HSS possible on Day 2 (20 Jan). An increase is then possible later in the period, probably on Day 4 (22 Jan), once any CME and HSS effects have begun to wane. It is difficult to judge the likelihood of significant electron charging occurring during this period until we see the strength of any HSS, however, so confidence in this is low.

As such, electron fluence is likely to stay below the Active threshold for much of this period, but with an increasing trend into Day 4. MOSWOC REFM is showing a level trend through the next 3 days, which is reasonable.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM latest



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